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(54) Method of heating glass sheet for laminated glass

Verfahren zum Erhitzen einer Glasscheibe für laminiertes Glas

Procédé de chauffage d'une feuille de verre pour verre laminé

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Description

The present invention relates to a sheet glass heating method, and more particularly to a method of heating a glass sheet for laminated glass.

Laminated glass, which finds wide use as front windshields of automobiles, is manufactured by heating first and second glass sheets to be paired in a heating furnace, shaping and annealing the glass sheets, and then joining the glass sheets face to face. The glass sheets may be shaped by a press shaping process, a gravity shaping process, or a roller shaping process. The first and second glass sheets are joined face to face by adhesive bonding with an intermediate film as of polyvinyl butyral sandwiched therebetween.

When the first and second glass sheets are to be bonded to each other, it is necessary that they be of a bent configuration having substantially the same shape. Basically, the first and second glass sheets are held under the same conditions in the heating furnace so that they are held at the same temperature To at the exit of the heating furnace.

The first and second glass sheets, from which laminated glass is to be constructed, may not necessarily have the same characteristics, such as thicknesses, material properties, and coloured conditions, at all times. For example, the first and second glass sheets may have different thicknesses, or the first glass sheet may be a coloured transparent glass sheet whereas the second glass sheet may be a colourless transparent glass sheet. If the first and second glass sheets have such different characteristics, then they tend to be held at different temperatures To at the exit of the heating furnace. As a result, the first and second glass sheets may not be shaped desirably, and may not appropriately be bonded to each other after they are shaped and annealed.

The present invention has been made in an effort to effectively solve the aforesaid problems of the conventional method of heating glass sheets for laminated glass.

It is an object of the present invention to provide a method of heating first and second glass sheets for laminated glass so that even if the first and second glass sheets have different characteristics, they can be held at the same temperature To at the exit of a heating furnace, can be shaped to desired configuration, and can well be bonded face to face to each other after they are shaped and annealed.

According to the invention, there is provided a method of heating a first glass sheet and a second glass sheet which are to be combined into a single laminated glass sheet, in at least a heating furnace before the first and second glass sheets are shaped, the first glass sheet being heatable more easily than the second glass sheet, said method being characterised by the step of feeding the first and second glass sheets over the same distance in the heating furnace at the same average speed; said heating step including the step of radiating a different intensity of heat to the first glass sheet from the intensity of heat radiated to the second glass sheet in the heating furnace.

The above and further objects details and advantages of the present invention will become apparent from the following detailed description of preferred embodiments thereof, when read in conjunction with the accompanying drawings.

FIG. 1 is a schematic plan view of a sheet glass bending apparatus which carries out the method of heating glass sheets for laminated glass according to the present invention;
FIG.2 is a fragmentary longitudinal cross-sectional view of the sheet glass bending apparatus shown in figure 1 which carries out a method of heating glass sheets for laminated glass according to a first embodiment of the present invention.
FIG.3A through 3C are views showing various sequences by which first and second glass sheets are heated;
FIG.4 is a fragmentary longitudinal cross-sectional view of a sheet glass bending apparatus, similar to figure 2, which carries out a method of heating glass sheets for laminated glass according to a second embodiment of the present invention;
FIG.5 is a transverse cross-sectional view of a sheet glass bending apparatus which carries out a method of heating glass sheets for laminated glass according to a third embodiment of the present invention;
FIG. 6 is a fragmentary longitudinal cross-sectional view of a sheet glass bending apparatus similar to figures 2 and 3 which carries out a method of heating glass sheets for laminated glass according to a fourth embodiment of the present invention; and
FIG. 7 is a graph showing the relationship between heating times and temperatures at the exit of a heating furnace when various glass sheets are heated in the heating furnace which is kept at a constant temperature therein.

FIG. 7 shows the relationship between heating times and glass temperatures at the exit of a heating furnace when four kinds of sheet glass are heated in the heating furnace which is kept at a constant temperature Ti therein. All the four glass sheets are sized 450 mm x 450 mm. The horizontal axis of the graph of FIG. 7 represents a heating time t and the vertical axis represents the glass temperature To at the exit of the heating furnace. The characteristics of the heated glass sheets are indicated by respective curves X1, X21, Y1, Y2.

In the experiment to obtain the data shown in FIG. 7, the heating furnace had ceramic rollers for feeding glass sheets and electric heaters inside of the furnace wall. The surface temperature of each of the heaters was controlled

so as to be at a desired level by a thermocouple. Specifically, the surface temperature of the heaters above the rollers was kept at 600°C, and the surface temperature of the heaters below the rollers was kept at 650°C.

	Thickness	Colour
X1	2.00mm	Blue (= coloured transparent glass)
X2:	2.3mm	Blue (= coloured transparent glass)
Y1:	2.00mm	Colourless (= colourless transparent glass)
Y2:	2.3mm	Colourless (= colourless transparent glass)

It can be understood from FIG. 7 that when the glass sheets are heated under the same conditions, the temperatures To of the coloured glass sheets at the exit of the heating furnace are generally higher than the temperatures To of the colourless glass sheets at the exit of the heating furnace. Comparison between the coloured glass sheets or the colourless glass sheets indicates that the glass temperature To at the heating furnace exit is higher where the glass sheet thickness is smaller.

If the shape, material property, or colour of a first glass sheet for laminated glass is different from the shape, material property, or colour of a second glass sheet, therefore, when the first and second glass sheets are heated under the same conditions, their temperatures To at the exit of the heating furnace are different from each other.

FIG. 1 schematically shows a sheet glass bending apparatus, generally designated by the reference numeral 400, which carries out a method of heating glass sheets for laminated glass according to the present invention. It is assumed that a single laminated glass sheet is constructed of first and second glass sheets G1, G2 and the first glass sheet G1 can be heated more easily than the second glass sheet G2.

The sheet glass bending apparatus 400 comprises a heating furnace 401, a press machine 402 disposed downstream of the heating furnace 401, a lehr 403 disposed downstream of the press machine 402, and a pick up device 404 disposed downstream of the lehr 403. A succession of rollers 406, (Fig. 2) serving as a conveyor, is disposed in the heating furnace 401.

In the sheet glass bending apparatus 400, the rollers 406 are disposed in and arrayed over the entire length of the heating furnace. Therefore, the first and second glass sheets G1, G2 are fed over the same distance at the same average speed in the heating furnace. However, the intensity of heat radiated to the first glass sheet G1 in the heating furnace is made lower than the intensity of heat radiated to the second glass sheet G2 in the heating furnace in the manner described below. As a result, the temperature To1 of the first glass sheet G1 at the exit of the heating furnace and the temperature To2 of the second glass sheet G2 at the heating furnace exit are equalized to each other.

In the sheet glass bending apparatus 400 according to a first embodiment of the present invention shown in FIG. 2, a series of gas burners 411 which can adjust the pressure of a supplied gas are disposed in the heating furnace 401. The pressure of a gas supplied to each of the gas burners 411 is adjusted to a certain level such that the gas burners 411 radiate a certain intensity of heat.

First, a first glass sheet G1 is introduced into the heating furnace 401 and fed by the rollers 406. While the glass sheet G1 is being fed in the heating furnace 401, the pressure of a gas supplied to the gas burners 411 is lowered by a control mechanism (not shown) thereby to reduce the quantity of heat radiated to the glass sheet G1. After passage of the glass sheet G1, the lowered gas pressure is increased again. Therefore, as the glass sheet G1 is progressively fed through the heating furnace 401, the gas pressures of the gas burners 411 are successively lowered and increased again. Following the first glass sheet G1, a second glass sheet G2 is introduced into and fed through the heating furnace 401 in which it is heated.

Preferably, first and second glass sheets G1, G2 are introduced into the heating furnace 401 such that glass sheets G1, G2 to be paired into a laminated glass sheet are disposed closely to each other. When the glass sheets G1, G2 are heated in the manner described above, they are alternately introduced into the heating furnace 401 as shown in FIG. 3A, and successive first and second glass sheets G1, G2 are combined into laminated glass sheets.

As shown in FIG. 3B, sets of two first glass sheets G1 and sets of second glass sheets G2 may alternately be introduced into the heating furnace 401, and successive two glasses G1, G2 or successive two glasses G2, G1 may be combined into laminated glass sheets.

Alternatively, as shown in FIG. 3C, sets of three first glass sheets G1 and sets of three second glass sheets G2 may alternately be introduced into the heating furnace 401, and each of the first glass sheets G1 in one set may be combined with the third following second glass sheet G2 in the next set, thereby making up a laminated glass sheet.

From the exit or terminal end of the heating furnace 401, the glass sheets G1, G2 are successively sent to the press machine 402 where they are pressed to shape.

When the first and second glass sheets G1, G2 are heated in the above fashion, the temperature To1 of the first glass sheet G1 at the exit of the heating furnace and the temperature To2 of the second glass sheet G2 at the heating furnace exit are equalized to each other.

Figures 4, 5 and 6 schematically show sheet glass bending apparatus, generally designated by reference numerals 500, 600 and 700 respectively which carry out methods of heating glass sheets for laminated glass according to second, third and fourth embodiments of the present invention.

As in the first embodiment, the rollers 506, 606, and 706 are disposed in and arranged over the entire length of the heating furnace.

In the sheet glass bending apparatus 500 shown in FIG. 4, a series of gas burners 511 which are vertically movable between lifted and lowered positions are disposed in a heating furnace 501. The gas burners 511 are usually held in the lowered position.

First, a first glass sheet G1 is introduced into the heating furnace 501, and fed by the rollers 506. While the glass sheet G1 is being fed into the heating furnace 501, the gas burners 511 are elevated to the lifted position by a control mechanism (not shown) thereby to reduce the intensity of heat radiated to the glass sheet G1. After passage of the glass sheet G1, the elevated gas burners 511 are lowered to the lowered position. Therefore, as the glass sheet G1 is progressively fed through the heating furnace 501, the gas burners 511 are successively elevated and lowered again. Following the first glass sheet G1, a second glass sheet G2 is introduced into and fed through the heating furnace 501 in which it is heated.

In the sheet glass bending apparatus 600 shown in FIG. 5 a series of gas burners 611 which are swingable laterally across the glass sheet feed path are disposed in a heating furnace 601. The gas burners 611 are usually directed downwardly.

First, a first glass sheet G1 is introduced into the heating furnace 601, and fed by the rollers 606. While the glass sheet G1 is being fed in the heating furnace 601, the gas burners 611 are swung laterally by a control mechanism (not shown) thereby to reduce the intensity of heat radiated to the glass sheet G1. After passage of the glass sheet G1, the gas burners 611 are returned to the downwardly orientated position. Therefore, as the glass sheet G1 is progressively fed through the heating furnace 601, the gas burners 611 are successively swung laterally and returned to the downwardly orientated position again. Following the first glass sheet G1, a second glass sheet G2 is introduced into and fed through the heating furnace 601 in which it is heated.

In the sheet glass bending apparatus 700 shown in FIG. 6, a series of gas burners 711 are disposed in a heating furnace 701. The heating furnace 701 houses a horizontal shield plate 712 disposed between the burners 711 and the rollers 706, the shield plate 712 being horizontally movable reciprocally along the glass sheet feed path in the heating furnace 701.

First, a first glass sheet G1 is introduced into the heating furnace 701, and fed by the rollers 706. While the glass sheet G1 is being fed in the heating furnace 701, the shield plate 712 is moved with the glass sheet G1 over a predetermined distance by a control mechanism (not shown) such that the shield plate 712 is positioned upwardly of the glass sheet G1. A second glass sheet G2 is introduced into the heating furnace 701, following the first glass sheet G1, and is heated while being fed in the heating furnace 701.

While the gas burners are illustrated in the above embodiments, other heating means such as electric heating wires or hot air may be used in place of the gas burners.

It will also be appreciated that while the first and second glass sheets G1, G2 in the embodiments of figures 4, 5 and 6 may be introduced in any of the patterns referred to in figures 3A to 3C.

With the heating methods according to the present invention, as described above, the temperatures To1, To2, at the exit of the heating furnace, of first and second glass sheets G1, G2 which are to be combined into a laminated glass sheet and which have different characteristics are equalized to each other. Therefore, the glass sheets G1, G2 can be pressed or otherwise processed into a desired shape. As a consequence, the glass sheets G1, G2 can well be bonded to each other after they have been shaped and annealed.

In the illustrated embodiments, it is necessary that the temperatures To1, To2 of the first and second glass sheets G1, G2 at the exit of the heating furnace be equal to each other. However, this requirement may not be satisfied if the glass sheets G1, G2 should be heated to different temperatures To1, To2 at the exit of the heating furnace depending on the condition in which the glass sheets G1, G2 will subsequently be bent to shape.

Although there have been described what are at present considered to be the preferred embodiments of the present invention, it will be understood that the invention may be embodied in other specific forms without departing from the scope of the claims.

Claims

1. A method of heating a first glass sheet (G1) and a second glass sheet (G2) which are to be combined into a single laminated glass sheet, in at least a heating furnace (401, 501, 601, 701) before the first and second glass sheets (G1, G2) are shaped, the first glass sheet (G1) being heatable more easily than the second glass sheet (2), said

method being characterised by the steps of:

feeding the first and second glass sheets (G1, G2) over the same distance in the heating furnace (401, 501, 601, 701) at the same average speed;
said heating step including the step of radiating a different intensity of heat to the first glass sheet (G1) from the intensity of heat radiated to the second glass sheet (G2) in the heating furnace (401, 501, 601, 701).

2. A method of heating a first glass sheet (G1) and a second glass sheet (G2) as claimed in claim 1, characterised by reducing the intensity of heat radiated from heaters (411, 511, 611, 711) in the heating furnace (401, 501, 601, 701) to the first glass sheet (G1).

3. A method of heating a first glass sheet (G1) and a second glass sheet (G2) as claimed in claim 1 or 2, characterised in that sheets (G1, G2) are heated by gas burners (411), the gas supply pressure to which is reduced when radiating the first glass sheet (G1).

4. A method of heating a first glass sheet (G1) and a second glass sheet (G2) as claimed in claim 1 or 2, characterised in that heating elements (511) are movable towards and away from the glass sheets (G1, G2) such that heating of the glass sheets (G1, G1) takes place with the heating elements (511) further from the first glass sheet (G1) than from the second glass sheet (G2).

5. A method of heating a first glass sheet (G1) and a second glass sheet (G2) as claimed in claim 1 or 2, characterised in that the heating elements (611) are movable laterally between a first position directed directly towards the second glass sheet (G2) and a laterally moved second position in which the heating elements are inclined towards the glass sheet (G1) so that the first glass sheet (G1) is heated in the second position and the second glass sheet (G2) is heated in the first position.

6. A method of heating a first glass sheet (G1) and a second glass sheet (G2) as claimed in claim 1 or 2, characterised in that a shield plate (712) is moved between heaters (711) and the glass sheets (G1, G2) during heating of the first glass sheet (G1).

7. A method of heating a first glass sheet (G1) and a second glass sheet (G2) as claimed in any preceeding claim characterised in that both glass sheets (G1, G2) have substantially the same temperature at the exit of the furnace.

Patentansprüche

1. Verfahren zum Heizen einer ersten Glaslage (G1) und einer zweiten Glaslage (G2), welche zu einer einzigen, laminierten Glaslage zu kombinieren sind, in wenigstens einem Heizofen (401, 501, 601, 701) bevor die erste und zweite Glaslage (G1, G2) geformt werden, wobei die erste Glaslage (G1) leichter aufheizbar ist als die zweite Glaslage (2), wobei das Verfahren gekennzeichnet ist durch die Schritte:

Weiterbewegen der ersten und zweiten Glaslage (G1, G2) über die gleiche Strecke im Heizofen (401, 501, 601, 701) mit der gleichen Durchschnittsgeschwindigkeit;
wobei der Heizschritt im Heizofen (401, 501, 601, 701) den Schritt des Strahlens von Wärmeintensität auf die erste Glaslage (G1) umfaßt, welche Wärmeintensität sich von der Wärmeintensität unterscheidet, welche auf die zweite Glaslage (G2) gestrahlt wird.

2. Verfahren zum Heizen einer ersten Glaslage (G1) und einer zweiten Glaslage (G2) nach Anspruch 1, gekennzeichnet durch das Reduzieren der Wärmeintensität, welche in dem Heizofen (401, 501, 601, 701) von Heizelementen (411, 511, 611, 711) auf die erste Glaslage (G1) gestrahlt wird.

3. Verfahren zum Heizen einer ersten Glaslage (G1) und einer zweiten Glaslage (G2) nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß Lagen (G1, G2) durch Gasbrenner (411) geheizt werden, wobei der Gasversorgungsdruck zu diesen reduziert wird, wenn die erste Glaslage (G1) bestrahlt wird.

4. Verfahren zum Heizen einer ersten Glaslage (G1) und einer zweiten Glaslage (G2) nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß Heizelemente (501) zu den Glaslagen (G1, G2) hin und von diesen weg bewegbar sind, so daß das Heizen der Glaslagen (G1, G1) mit den Heizelementen (511) entfernter von der ersten Glaslage (G1) als von der zweiten Glaslage (G2) stattfindet.

5. Verfahren zum Heizen einer ersten Glaslage (G1) und einer zweiten Glaslage (G2) nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Heizelemente (611) seitlich zwischen einer direkt zur zweiten Glaslage (G2) hin gerichteten ersten Stellung und einer seitwärts bewegten zweiten Stellung bewegbar sind, in welcher die Heizelemente zur Glaslage (G1) hin geneigt sind derart, daß die erste Glaslage (G1) in der zweiten Stellung geheizt wird und die zweite Glaslage (G2) in der ersten Stellung geheizt wird.

6. Verfahren zum Heizen einer ersten Glaslage (G1) und einer zweiten Glaslage (G2) nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß eine Schirmplatte (712) während dem Heizen der ersten Glaslage (G1) zwischen den Heizelementen (711) und den Glaslagen (G1, G2) bewegt wird.

7. Verfahren zum Heizen einer ersten Glaslage (G1) und einer zweiten Glaslage (G2) nach einem der vorangehenden Ansprüche, dadurch gekennzeichnet, daß beide Glaslagen (G1, G2) am Ausgang des Ofens im wesentlichen die gleiche Temperatur aufweisen.

Revendications

1. Procédé pour chauffer une première feuille de verre (G1) et une seconde feuille de verre (G2) qui doivent être assemblées en une seule feuille de verre feuilleté, dans au moins un four de chauffage (401, 501, 601, 701) avant que les première et seconde feuilles (G1, G2) soient formées, la première feuille de verre (G1) pouvant être chauffée plus facilement que la seconde feuille de verre (2), ledit procédé étant caractérisé par les étapes consistant à :

   amener les première et seconde feuilles de verre (G1, G2) sur la même distance dans le four de chauffage (401, 501, 601, 701) à la même vitesse moyenne ;
   ladite étape de chauffage comprenant l'étape consistant à faire rayonner une intensité de chaleur différente vers la première feuille de verre (G1) de l'intensité de chaleur rayonnée vers la seconde feuille de verre (G2) dans le four de chauffage (401, 501, 601, 701).

2. Procédé pour chauffer une première feuille de verre (G1) et une seconde feuille de verre (G2) selon la revendication 1, caractérisé par le fait de réduire l'intensité de chaleur rayonnée par les réchauffeurs (411, 511, 611, 711) dans le four de chauffage (401, 501, 601, 701) vers la première feuille de verre (G1).

3. Procédé pour chauffer une première feuille de verre (G1) et une seconde feuille de verre (G2) selon la revendication 1 ou 2, caractérisé en ce que les feuilles (G1, G2) sont chauffées par des brûleurs à gaz (411), leur pression d'alimentation en gaz étant réduite lors du chauffage par rayonnement de la première feuille de verre (G1).

4. Procédé pour chauffer une première feuille de verre (G1) et une seconde feuille de verre (G2) selon la revendication 1 ou 2, caractérisé en ce que les éléments de chauffage (511) sont mobiles vers et à partir des feuilles de verre (G1, G2) de manière que le chauffage des feuilles de verre (G1, G1) se fait avec les éléments de chauffage (511) plus loin de la première feuille de verre (G1) que de la seconde feuille de verre (G2).

5. Procédé pour chauffer une première feuille de verre (G1) et une seconde feuille de verre (G2) selon la revendication 1 ou 2, caractérisé en ce que les éléments de chauffage (611) sont mobiles latéralement entre une première position dirigée directement en direction de la seconde feuille de verre (G2) et une seconde position décalée latéralement dans laquelle les éléments de chauffage sont inclinés en direction de la feuille de verre (G1) de sorte que la première feuille de verre (G1) est chauffée dans la seconde position et que la seconde feuille de verre (G2) est chauffée dans la première position.

6. Procédé pour chauffer une première feuille de verre (G1) et une seconde feuille de verre (G2) selon la revendication 1 ou 2, caractérisé en ce qu'une plaque de protection (712) se déplace entre les réchauffeurs (711) et les feuilles de verre (G1, G2) pendant le chauffage de la première feuille de verre (G1).

7. Procédé pour chauffer une première feuille de verre (G1) et une seconde feuille de verre (G2) selon l'une quelconque des revendications précédentes, caractérisé en ce que les deux feuilles de verre (G1, G2) ont sensiblement la même température à la sortie du four.

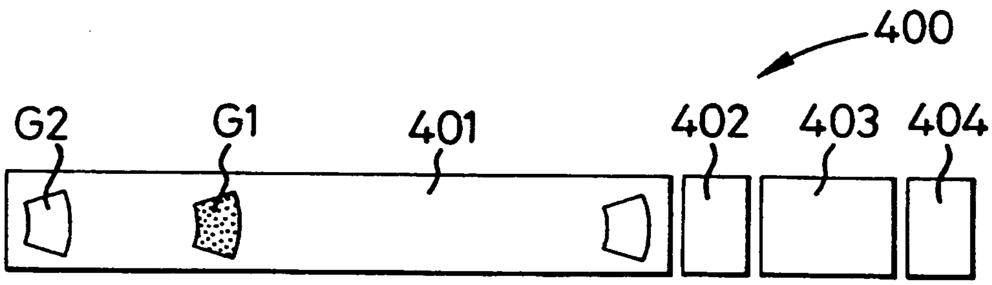

FIG.1

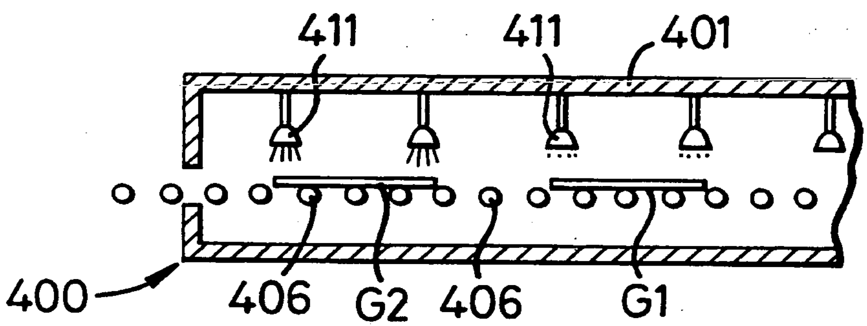

FIG.2

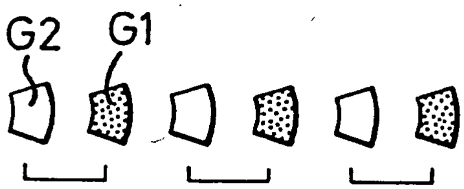

FIG.3A

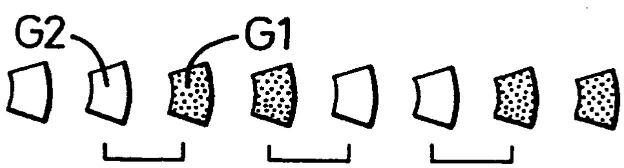

FIG.3B

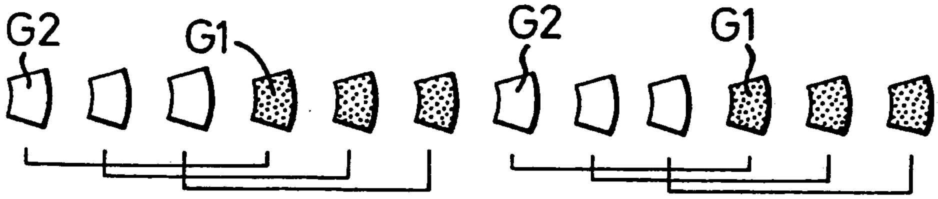

FIG.3C

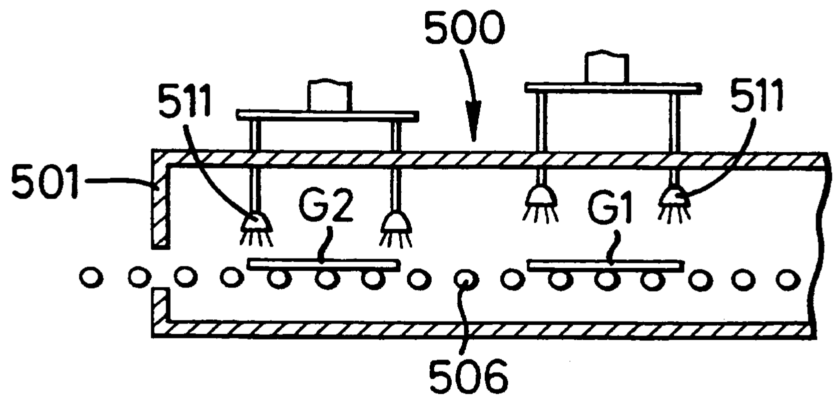

FIG.4

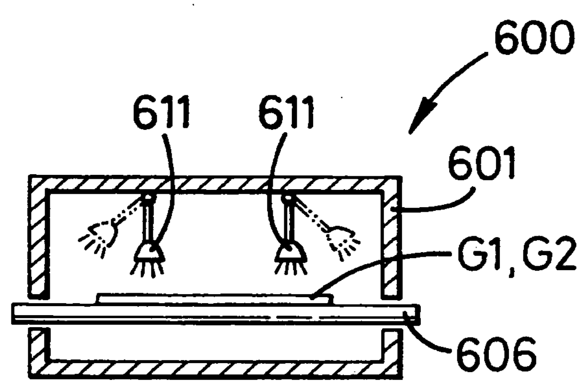

FIG.5

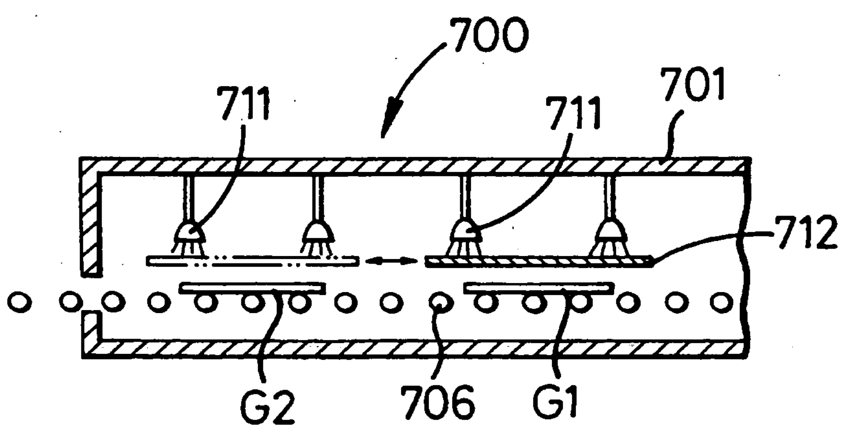

FIG.6

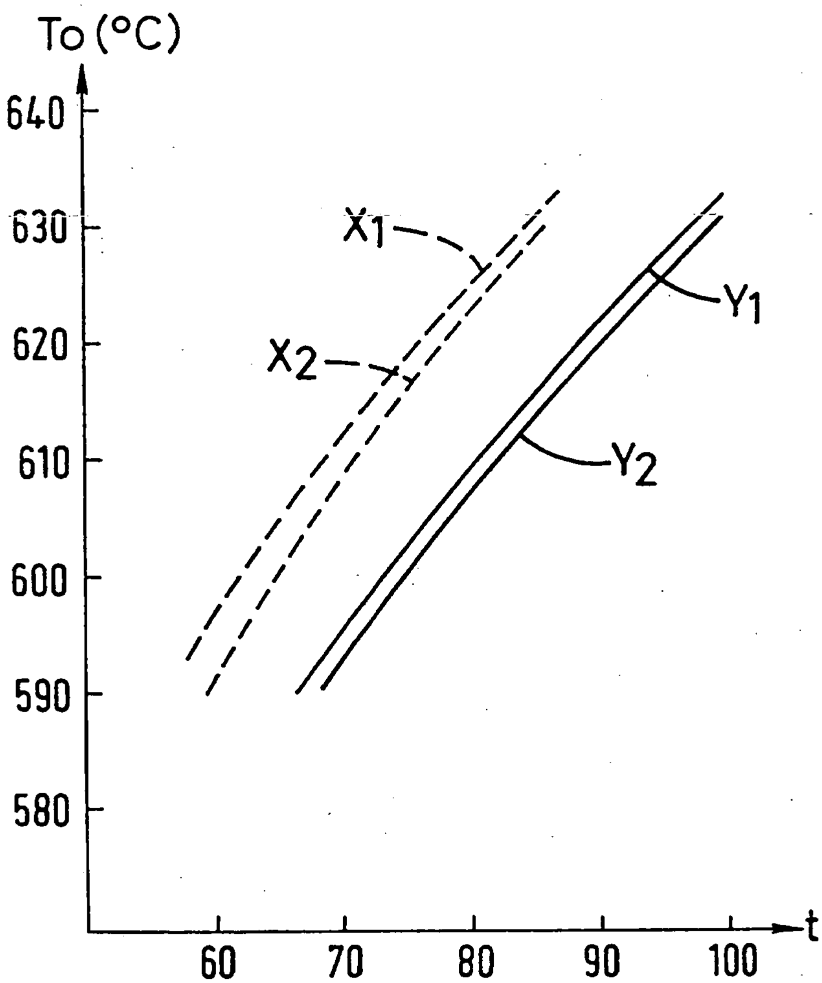

FIG.7